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OFFICIAL PROCEEDINGS

Meeting of February, 1921

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REPORT OF FEBRUARY MEETING

also

PAPER AND DISCUSSION ON
SOME ENGINEERING FEATURES OF TRAMWAY OPERATION.

Canadian Railway Club

INCORPORATED

Official Proceedings

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PROCEEDINGS OF THE CANADIAN RAILWAY CLUB.

Windsor Hotel, Montreal, Feb. 8, 1921

Chairman, (Mr. W. H. Winterrowd).

Gentlemen, we are in a somewhat larger room tonight than we have been in the habit of occupying in the past. In order to make this a "get-together" meeting, and also that we may be able to hear each other better, I would like to suggest that the gentlemen at the rear of the hall move to the front seats. It will also enable the Stenographer to hear what is said if everybody is close to the front.

I would also like to call attention to the cards which you will find on the seats. Please fill out one of these cards whether you are a member or not as we would like very much to have a record of everyone here tonight. When filled out please pass the cards down to the centre aisle and the Secretary will pick them up a little later on.

We will dispense with the reading of the minutes of the previous meeting. The Secretary advises they have been mailed to you today. The Secretary will now read the list of applicants for membership.

Secretary:

Mr. President and gentlemen. — The following is list of applicants for membership:

New Members.

R. Besse, Confract Foreman, Canadian Pacific Railway, 1920a Chateaubriand Street, Montreal.

E. W. Bell, Service Engineer, Canuck Supply Co. Ltd, 418 St. James Street, Montreal.

W. E. Castleman, Locomotive Engineer, Grand Trunk Rail way, 146 G. E. Cartier Pk., St. Henry.

Albert Davis, Machinist, C.P.R. Angus Loco. Shops, Mon treal, P. Q.

T. M. Hyman, Master Car Builder, Grand Trunk Railway, Montreal, P. Q.

M. A. Jack, Contract Foreman, Canadian Pacific Railway, 311 Marquette Street, Montreal.

R. Jones, Clerk, Car Service Department, Grand Trunk Rail-way, 238a Rushbrooke St., Verdun.

B. Kennedy, Representative, Wm. Beardmore Company, Room 704 Guarantee Building, Montreal.
P. L. McAvoy, Superintendent Vapor Car Heating Co. of Canada Ltd., 65 Dalhousie Street, Montreal.
D. Milne, Asst. Foreman, Frog Shop, Canadian Pacific Railway, 1201 DesErables Street, Montreal.
M. J. O'Donnell, Eastern Representative, Herbert Norris Crane Co., P O. Box 2243, Montreal.
H. A. Palmer, Asst. Land Commissioner, Grand Trunk Railway, 94 McGill Street, Montreal.
J. H. Pringle, Asst. Engineer, Grand Trunk Engineering Dept., Montreal, P. Q.
W. A. Spence, Asst. Electrical Foreman, Canadian Pacific Railway, Angus Shops, Montreal.
F. Savoy, Engineer, Grand Trunk Railway, 13 Harvard Ave., Notre-Dame de Grace.
H. Sockett, Salesman of Railroad Specialties, James Robertson Co., Limited, Montreal.
H. P. Stanley, Civil Engineer, 207 Coristine Building, Montreal.
H. C. Woodbridge. Representative, Locomotive Stoker Company, 200 Westinghouse Building, Pittsburg, Pa.
T. Winder, Contract Foreman, Canadian Pacific Railway, Angus Shops, Montreal.

Chairman:
Gentlemen, you have heard the list as read. A motion of acceptance is in order.

Mr. W. H. Sample:
I move the acceptance of these applications.

Mr. John Hendry,
Seconded.

Chairman:
Moved by Mr. Sample, seconded by Mr. Hendry that these applications be accepted. All in favor please signify in the usual way.
Carried.

MEMBERS PRESENT.

Ahern, T.	Allyn, A. W.	Arnold, D. R.
Angus, D.	Armstrong, H. T.	Ayers, J. R.

Bare, H. S.
Barrett, C. W.
Beaumont, R. J.
Benger, F. O.
Berger, W. A.
Black, R. H.
Bolan, W. M.
Boughton, L.
Brady, C.
Brazier, G. W.
Britton, J. H.
Bronsdon, M. H.
Brooks, E. B.
Brooks, P. A.
Brown, A. D.
Buckland, A. W.
Buckle, W. E.
Burns, E. W.
Burns, J.
Cameron H. W.
Camillard, A.
Chown, T. C.
Clibbon, A. .
Coleman, M. T.
Crawford, R.
Crockett, W. B.
Crumpton, A.
Desparois, D.
Donnelly, M. R.
Duffy, C. N.
Dyke, H. J.
Eddison, E.
Ferguson, A.
Fielding, W. G.
Fradd, F. J.
Gale, G. G.
Gardner, K.
Gaudet, Col. F.
Gregory, W. A.
Gillmor, W. D.
Godin, R. V.
Going, A. S.
Gordon, N. G.
Goslin, A.
Graves, W. A.
Graves, W. F.
Gray, C. W.
Greenough, W. C.
Hampshire, A.
Hamm, W. C.
Hannaford, H.
Harvey, R. H.
Hayden, J. E.
Hebert, C.
Hendry, J.
Hickman, F. C.
Holland, Norman.
Horwood, W. W.
Hunter, P. S.
Hunter, W. C.
Hutcheson, J. E.
Ivory, W. M.
Johnston, J.
Jones, J. A.
Jones, R.
Kendall, G. H.
Kennedy, J. W.
Kingsland, E.
Kinnear, C. R.
Kierans, Thos.
Kurfess, L. S.
Liddy, S. J. W.
Lloyd, E. E.
Lloyd, G. H.
Lowe, T. S.
Lowe, W. S.
Lytle, A. C.
Marchant, A.
Meissner, O. W.
Milne, D.
Monks, J. H.
Moore, J. H.
Morgan, W.
Morin, F.
Monroe, K. E.
Morrison, W.
Murphy, J.
Merryfield, J. A.
Macken, J. R.
Mackie, R. L. D.
Macnab, E. S. M.
McCallum, W. A.
McGoldrick, F. J.
McHattie, J.
McIntyre, J. S.
McLacklan, J.
Naylor, H. R.
O'Donnell, M. .
Palme, J. E.
Parks, G. E.
Paxton, J. D.
Pepper, A. H.
Petersen, W. A.
Pierpoint, F. H.
Pope, A.
Pope, J. G.
Pringle, J. H.
Prowse, W.
Reid, W. M.
Robertson, J. A. S
Robertson, J.
Robertson, N. A. H
Ross, N. E.
Royer, C.
Russell, G.
Sample, W. H.
Schellans, E. L.
Seccombe, A. G.
Shortley, B. F.
Sherwood, F. H.
Sleigh, T.
Smith, E. D.
Spidy, E. T.
Stewart, E. A.
Steward, H. M.
Stuart, H. W.
Stockwell, F. F.
Summers, W. S.
Symmes, H. H.
Tilt, E. B.
Tinkler, C.
Thorburn, C. B.

Thorp, H.N.	Wheatley, J.	Winship, R. B.
Towne, A. C.	Wheatley, J. H.	Winterrowd, W. H.
Venon, B.	Webb, W. C. H.	Wiseman, G. G.
Vernon, B.	Wilding, G. G.	Booth, W. A.
Viberg, E. P	Wilding, Geo. G.	and others.

Chairman:

Gentlemen, you have read the advance copies of the paper of the evening which have been distributed. I want to say that I think this club is to be congratulated upon having a paper such as the one to be read to-night. It is to be given to us by a man who stands at the head of his profession, not only in Canada, but on this continent. I have been in a good many cities both in Canada and the United States, and I feel sure that every one here will agree with me when I say that in Montreal we have the finest tramway equipment and service of any city on the continent. There are some very interesting problems in connection with the operation of the tamways and these problems will be presented to us tonight by Mr. D. E. Blair, Superintendent, Rolling Stock, Montreal Tramways Co. I take great pleasure in introducing Mr. Blair, who will now read his paper.

SOME ENGINEERING FEATURES OF TRAMWAY OPERATION.

The author has been requested by your executive to read before you a paper dealing with the operation of Tramways.

A treatise on this subject was prepared for, and presented to a limited audience namely the Engineering Institute of Canada, a short time ago.

Your executive seems to think that this paper is worthy of wider circulation and since the subject is one that has been given a great deal of thought by the author and is of direct interest to everyone here, it is hoped that its further discussion before you will be of interest and benefit.

The plan of the paper is to discuss, in a general way, the various factors which must be recognized in order that an efficient system of transportation may be enjoyed by the population of our larger cities.

An effort will be made to clearly draw the line between those factors whose development lies in the hands of the operating Company and those from which beneficial results can only come through the help of the public.

The author has attempted to analyse and give a technical demonstration of the importance of each factor so that the subject may be considered in true perspective.

The matter of urban transportation has always been a vital factor in the life of City Dwellers but in a passive sense. The public at large are now active partners in the operation, as well as the users or patrons, of the street cars of many cities and we should now realize that the street car service in any large community serves a greater number of people and is of greater importance than any other form of traffic and should therefore be given prior rights, within reason, over all other vehicular traffic, at least on those streets on which tramway cars circulate. Since the rate of fare and the quality of service rendered depend entirely on the overall efficiency of operation, it seems to be an opportune time to bring to the attention of this influential Society the great importance of educating street car users to a fuller understanding of the fundamental factors that make for efficient and satisfactory transportation.

It is of great importance that they should know, and fully appreciate how and to what extent, the hearty co-operation and good-will of the Public, and of the Municipal Authorities, is necessary to the consummation of the carefully worked out plans of the management of Public Utility organizations toward further improvements.

It may be stated that the present equipment available and in general use has reached a very high standard. No consideration of cost or lack of engineering skill stands in the way of further progress and the art has reached a stage where little remains to be done, that is within the control of railway managers, to improve the standards of modern car service.

Under existing conditions we have reached a point very near to maximum theoretical efficiency and this question presents itself: Can existing conditions be modified, without injury to other interests, so as to result in improvements that are worth while?

The development of street transportation has not been confined to any particular locality on this continent but is the composite result of painstaking effort distributed from coast to coast. Methods and practices have always been wide open for comparative study and full advantage has been taken of this fact.

Many recognized opportunities for improvement still remain undeveloped, owing largely to a strange unreasoning attitude of the public against any reforms that are suggested by the "cap-

italistic monsters who thrive in idleness upon the fabulous wealth wrung from the hands of those who toil."

This is the mental fog that must be dispelled by education before much further progress can be made.

The financial operations of many of the larger transportation ventures of this country are now laid bare to public scrutiny.

Public Commissions now supervise every transaction and have more than a theoretical control of actual operation.

It is interesting to note that the rapidly increasing rates of fare are coincident with the increasing effectiveness of public supervision.

GENERAL ARGUMENT.

The primary requisites of a satisfactory system of transportation may be stated as follows:—

1st.—SPEED.
2nd.—SAFETY.
3rd.—COMFORT.
4th.—CONTINUITY OF SERVICE.
5th.—FREQUENCY OF SERVICE.
6th.—CONVENIENCE OF SERVICE.

In addition to and closely associated with each of these is the question of *economy* but it is not the writer's intention to preach economy where depreciation of any of these factors is the result.

Any increase in the Standards of the last five items is likely to add to the cost but it is well that we should realize that *increase of speed* within the practical limitations of street traffic, will tend toward *greater economy* without necessarily affecting the question of *safety* and higher speed will add very materially to the efficiency of the service.

Speed of Transportation may in fact be considered as the fundamental requirement of a satisfactory service and it should, therefore, be the outstanding objective of all effort toward improvement.

By Speed or Schedule Speed is meant the average or effective speed with which a car covers distance and this should not be confused with velocity at any given moment or with the maximum Speed attained between stops.

In order to intelligently analyse the question of Schedule Speed it is necessary to introduce a very convenient figure which allows us to dissect and study the fundamentals of all traffic movement, viz: the *Speed Time Curve.*

SPEED TIME CURVE.

The movement of a street car from one end of a line to the other is made up of a series of hops or cycles from station to station or from stop to stop and it will be one of the chief purposes of this paper to show to what extent the public would benefit by a radical increase of the distance between stops. If they would once realize this fact, they would *insist* upon an immediate change.

These cycles vary in length and the time necessary to operate over each one is subject to conditions of grade, density of traffic etc., but a study of a single average cycle will bring out all the characteristics of a series of such cycles which consitute any run.

What happens in such a cycle can be represented very accurately by a diagram constructed of four distinct elements representing each of the four factors of which any typical run or cycle is constituted.

The variation in speed of any moving object may be represented graphically by a series of points the *height* of these points above a basis line being in proportion to the *speed* and the distance from a vertical line of reference being a measure of the *time after* the beginning of the cycle at which each speed is observed.

Thus a constant speed would be represented by a horizontal line poining the observed degrees of speed or velocity.

Thus also a line slanting upwards represents the movement of an object whose speed is increasing and a line sloping downward indicated a decreasing rate of motion.

The four component elements of our curve are as follows:—

1st. Period of *ACCELLERATION* from Rest to Maximum Speed under the action of propelling forces.
2nd. Period of *COASTING* without applied power and without restriction of motion other than from friction.
3rd. Period of *DECELLERATION* or Slowing Down under the retarding action of Brakes and friction.
4th. Period of *REST* at Stopping Points.

Each of these periods is subject to certain practical limitations but each one is also affected by variable elements, some wholly within the control of the operating crew, some depending entirely upon the passengers, and others subject to motor capacity, interference of independent traffic, physical conditions etc. The efficiency of the whole is dependent upon the co-operation of the general public for whose benefit the cars

are operated but who are prone to magnify the value of petty advantages to the individual at the expense of the general welfare. Control of traffic by the Municipal Authorities also has a serious bearing on the matter

Because of the practical limitations controlling each factor and because the question of economy is also of interest, further explanations are advisable.

ACCELLERATION PERIOD

The rate of *increase* of speed is in proportion to the resultant of all the forces acting on the car. The forces applied to produce motion are rarely limited by the capacity of the motors but should be controlled within a reasonable degree of comfort to the passengers.

The rate is absolutely limited by the amount of tractive effort that may be developed between wheel and rail before wheel slipping occurs.

As to *comfort,* the sensations due to change of speed are not so much due to a high rate of accelleration as to sudden changes in the rate of accelleration. A constant rate of 5 F.P.S. P.S. has no disagreeable effects, but a sudden change from a rate of 2 F.P.S. to 3 F.P.S. P.S. is quite noticeable and annoying.

For this reason the high rates attained with the help of automatic methods of control in use on the New York Subways or on the 2-Car Trains in this City are not noticed as much as the jerky motion resulting from control changes under the hand judgment of the motorman of an ordinary car.

The rate of accelleration under either method of control is under the control of motorman and is, of course, subject to rail conditions.

It is of considerable importance as effecting Schedule Speed —Maximum Speed—Safety, and Economy.

A certain definite amount of energy must be applied to a body of known weight in order to impart a given speed to that body. In the case of a car in City service the energy absorbed in overcoming friction is quite small.

A very large proportion of the applied energy is utilized to overcome the inertia of the car.

The power necessary to propel a 25-Ton Car at a constant speed of 8 M.P.H. is only 10.7 *H.P.*.. To accellerate this same car at a reasonable rate of 2 M.P.H. per second requires 230 *H.P.*

Attention may be called to the wide difference between the

controlling factors of Steam Railway Trunk Line practice and that of Street Railways.

Freight movement, especially, is controlled by the relation of weight on engine drivers to total tonnage hauled . Rate of accelleration is not of primary importance provided an engine may start a standing train and negotiate ruling grades. Steaming capacity is then provided to maintain a reasonable speed over relatively long distances.

Street car equipment on the other hand is designed primarily to produce quick accelleration.

Motor capacity is then ample for the operation of grades up to nearly 15 per cent.

All of the energy applied to overcome inertia and, therefore, impart speed at the beginning of a cycle remains stored up in the car, by virtue of its motion, in the form of Kinetic Energy and is available to perform useful work in overcoming frictional and other resistances throughout the rest of the cycle of motion.

It is a fact, not generally recognized, that, within the limits of wheel slippage, the *faster the rate of accelleration* of a street car the *less power is consumed* to produce a given speed.

This is partly due to the inherent characteristics of the series wound motors universally applied to this kind of work.

These characetrisics are such that a series motor is capable of producing maximum torque at maximum efficiency at the low speeds at which a large part of the total work within a cycle is performed. A high value of motor efficiency is maintained at the higher speeds as well. A further outstanding advanage is that it will automatically adjust its speed in keeping with the nature of the work it has to perform, thus tending to keep down the current drawn from line within the limits of its capacity.

The speed of the motor *under a given load* is definitely fixed by the voltage applied to its terminals. The *line voltage* being constant and the maximum current allowable during accelleration being limited, it is necessary to absorb the *excess* voltage during that period by switching inert resistance into the main motor circuit.

For this reason *about one half of the energy drawn from line during the time of controlled accelleration is absolutely wasted in the rheostats.*

It is, therefore, desirable to shorten this period and to impart as much of the final speed as possible after all wasteful resistance has been eliminated and the motors are working at a high overall efficiency.

The importanec of fast accelleration goes far beyond the question of energy wasted in rheostats.

High speed is essential if we wish to overcome *space* in minimum *time*. It is obvious that the more quickly the maximum speed of a given run is reached, the shorter the time that will be necessary to cover the distance between stops, or, to state this in another way: The higher the *average speed* throughout the run the lower will be the *maximum speed* necessary to traverse a given distance in a given time.

It is to be noted that the element of danger in the operation of vehicles of any kind is qualified by *maximum speed* attained rather than by the more reasonable average speed. It was previously mentioned that average or schedule speeds can be increased without increasing the hazard. Here is the explanation and this will be referred to again.

COASTING PERIOD.

It was previously stated that a large part of the total energy required to operate a Street car is utilized to overcome inertia and impart speed. The kinetic energy stored up in the car at a given speed during each cycle is proportional to one half its weight multiplied by the square of its velocity in feet per seconds.

If the operating conditions are such that the brakes must be applied as soon as the power is turned off, practically all of this energy is absolutely wasted in the form of heat developed at the brake shoes This is undesirable.

If however, the run characteristics are such that after a certain maximum speed has been promptly reached, power can be shut off and and the car allowed to roll or coast for a greater or less distance before the application of brakes, then a certain proportion of this stored energy is utuilized to good advantage in overcoming the frictional resistances during the remainder of the run.

During this period the car will slow down gradually losing about one mile per hour of speed in every five seconds.

The brakes are applied at a lower speed than in the previous case and, besides the saving of power, there is a distinct saving in wear of brake shoes and wheels.

The length of this coasting period in the analysis of any run gives a very definite indication of the efficiency of the motorman).

It is to b noted here that this desirable period can be

lengthened by cutting down the other three viz: Accellerating, Breaking and Rest Periods.

BRAKING PERIOD.

The rate of decelleration or braking is under the control of motorman and subject to conditions of rail friction and comfort of passengers.

A maximum rate of 3 1-2 miles per hour per second is possible but seldom reached on open streets. A high practical standard is about 2 miles per hour per second.

The only point of special interest here is that, for the same reasons as given under the heading of Accelleration a maximum rate of braking should be developed at the beginning of the period when the speed is greatest. It is evident that as much distances as possible should be covered while the car is running free at a high speed and that brakes should be applied for as short a time as possible. The average speed during the application of brakes is only about half of the initial speed at which brakes were applied and it is evidently desirable to shorten the time during which this reduced speed is effective to overcome distance.

PERIOD OF REST

Since *movement* is the *primary object* of transportation it is evidently desirable that the stops should be as short as possible and here is where the co-operation of the passengers is of greatest importance.

In order that this fact may be impressed upon the mind while further discussion proceeds, it may be stated that since the rates of accelleration and braking can be fixed at a practical maximum, every second wasted while the car is at rest is equivalent to a loss of distance equal to one second's travel at maximum speed, say twenty miles per hour viz: about thirty feet per second.

Experience and careful recording of actual conditions has shown that good traffic control, prompt movement of passengers, alert action by the conductor and immediate response of motorman to his signals will result in practical loading and unloading delays as low as one second per passenger in fairly large batches and three seconds per passenger when only one or two passengers are handled.

It is claimed that the average length of stop in some cities is less than three seconds.

Actual conditions existing in Montreal do not compare favorably The reasons are perhaps not so much due to lack of energy or to inherent slowness of movement of the local population but rather to the fact that the public has not been educated to a realization of the great advantages to themselves that would result from a snappier movement when in the vicinity of the steps of a standing street car.

It must be remembered that each car on a busy line is just one of many links in a moving chain and any delay suffered by one car is reflected back to every other car in the line so that the speed of the whole is limited to the speed of the slowest car.

Other means of eliminating these wasted moments which when all added up result in considerable loss of time and speed are as follows:—

(1) Passengers having change or tickets ready and in hand for deposit when boarding car. Fumbling in pockets and handbags, on crowded platforms, and tender of bills when purchasing tickets are very efficient methods of annihilating speed.

(2) Clearing of Entries and Exits thus assisting free movement.

(3) Movement of descending passengers toward doorways in advance of actual stoppage of car.

(4) Provision by the Municipal Authorities of safety zones at congested points where intending passengers may form in queues at the exact location where the car step will be stopped.

(5) Better control of promiscuous traffic at certain crowded intersections at busy hours.
At certain points the public should demand that all but street car traffic be prohibited at rush hours. At other points left hand turns of vehicles should be prohibited and automobiles and other vehicles should not be allowed to park at the curb within a block on the near side of intersections. This allows moving vehicles to remain on the roadway rather than encroach on the car tracks.

(6) Prevention of overcrowding of cars. Delays from this cause are very serious and reforms in this direction will require the serious and welll organized co-operation of the police with the more thoughtful element of the public.

It will perhaps be some time before the public will realize that the Company is losing money when cars are crowded to

the point where length of stops are apprepciably increased and furhter to appreciate the fact that if crowding were not permitted, anyone could afford to let half a dozen cars go by and still get home sooner than they do when overcrowding exists.

The cause of congestion at certain downtown loading points is that during certain periods the number of people requiring transportation is larger than can be handled by the number of cars that can be operated past these points on limited track facilities. A sufficient number of cars is usuually available. These form a long procession ready to perform useful work but are forced to crawl along at snail's pace owing to the excessive time lost in leading by each unit at the head of the procession.

There are times when because of the danger attendant upon starting cars while a crowd is surging around the steps, that more than a minute elapses between the despatch of successive cars. Each of these may carry one hundred and twenty-five passengers. Three times as many cars could be sent away loaded with eighty to one hundred passengers each if crowding were elimnated and the Company as well as the public, would profit by the change.

Elementary arithmetic will show that six equally spaced cars running around a loop at 12 M.P.H. will transport as many passengers as twelve cars running in the same loop at half the speed or 6 M.P.H.

Why then should the public not co-operate with the Company to run all the twelve cars at 12 miles per hour with half the number of passengers in each car.

Under present conditions operating companies are providing far more cars than are necessary to perform the relatively poor service rendered but it is *physically impossible* to bring these cars into *efficient* and *expeditious* service on account of slow despatch of car units past congested areas.

If we always keep in mind the idea that every car on every city line can be considered as a link in an endless chain belt, it will be easy to realize the advantages that would accrue to both the public and the Company if the speed of the whole chain can be increased.

The strap Hanger may quite properly be said to pay the dividends but the rear platform acrobat is a general nuisance and should be treated as such.

The general features of the several elements of the speed time Curve have been discussed at some length and we may now proceed to a technical study of the curve as a whole.

Before doing so, it is advisable to call attention to what is perhaps the most important factor bearing on the question of faster schedule speeds viz: "The number of stops per Mile' or the *Spacing of Stops*

We must know the *number* as well as the *duration of the stops* before we can form any idea of the time necessary for a car to travel over a given route.

It will be shown that after the highest possible speeds have been reached as a result of close co-operation between the Operating Company and the public, it is yet easily possible to make remarkable improvements in Schedule Speeds simply by reducing the number of stops.

Under prevailing conditions, here and elsewhere, it is not found practicable to make better speed than eight miles hour when a car has to make ten stops per mile. About nine miles per hour is the maximum possible speed that can be made within the limits of accelleration, braking, and time of loading previously mentioned when making ten stops per mile.

You will see, however, that by the simple expedient of increasing the distance between stops from 528 ft. to 880 ft., it is easily possible to maintain a practicable schedule speed under exactly thet same operating conditions, of 12 M.P.H.

In other words, by adding 352 ft. or 66 % to the distance between stops a trifling matter when studied intelligently, we can add 50% to the effective speed of every car on the system.

The element of safety is not affected and the higher speed meeans that every passenger will get to his destination in one third less time.

One hour is cut down to forty minutes. Three quarters of an hour to thirty minutes.

Why has this practice not been adopted? Simply because the voice of the individual who runs a banana-stand, at a street corner where a stop has been eliminated, is louder than the demand of the public for a constructive plan of improvement in their car service.

Incidentally it will be shown that the possibilities of increasing prevailing schedule speeds in this direction is not striking until the average distance between located stops is greater than 528 ft., or ten stops per mile.

As spacing is increased beyond this limit, the advantages are very interested and the opinion may be expressed that there is no good excuse for placing stopping points less than 800 ft. apart.

ANALYSIS OF SPEED TIME CURVES.

It has been stated that the accelleration and braking rates have definite limits. It is not practicable to accellerate or brake faster than two miles per hour per second. Up to this limit however, the motorman has complete control and can vary the rates at will. These periods then being of less direct interest to the public, it will be necessary here to merely indicate in which direction the motorman's efforts should be turned in order to produce the high average speeds which this paper advocates.

CHART NO. 1—ACCELERATION.

Considering accelleration first, take two examples of one and two miles per hour per second respectively. The straight line part represents the speed of the car as the power is gradually turned on by the motorman. When power is full on the inherent characteristics of the motors determine how the speed will continue to increase.

After *ten seconds of operation* with an initial accelleration of 2 *M.P.H. P.S.*, a distance of 140 *ft.*, has been covered It will be found that it requires *fourteen seconds* operating the other way to cover the same distance. Four seconds of time have been lost, during which the first car has gained about 100 ft. on the second.

Obviously slow accelleration does not make for high schedule speeds, and therefore fast accelleration, up to the limit imposed by comfort of passengers shouldd be encouraged.

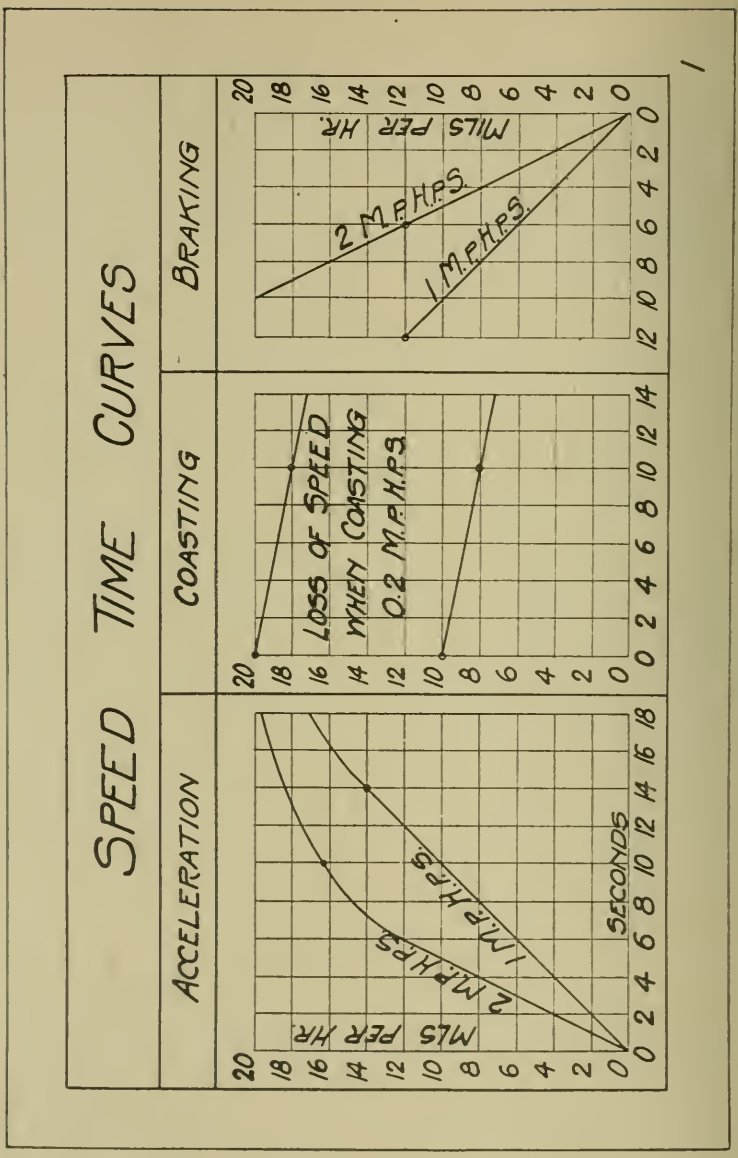
Power is being consumed during the whole accelleration period and it will be shown that not only does fast accelleration make faster schedules possible, but that in a given schedule, fast accelleration allows the cycle to be performed at a smaller power cost.

COASTING

The action of the car while coasting is entirely out of the hands of the crew and on level track the car retards at the rate of two miles per hour in ten seconds no matter what speed the car had when coasting commenced.

Obviously a car retarding from 20 to 18 *M.P.H.* in *ten seconds* will cover more distance than a car retarding from 10 to 8 *M.P.H.* in *ten seconds.*

It is absolutely essential that in practice a certain amount of coasting be allowed in the average cycle; otherwise when delays occur the car cannot regain time.


SPEED TIME CURVES
ACCELERATION
COASTING
BRAKING
MILS PER HR.
SECONDS
2 M.P.H.P.S.
1 M.P.H.P.S.
LOSS OF SPEED
WHEN COASTING
0.2 M.P.H.P.S.
MILS PER HR.
2 M.P.H.P.S.
1 M.P.H.P.S.

Here then is a further argument for fast accelleration. Since *high initial coasting speed is desirable* and the *total time in motion is limited, the only way to obtain that speed is to accellerate quickly to it.*

BRAKING.

The same reasoning applies to the reverse operation of braking. Consider two cases where cars are braked from 12 milse per hour at rates of 2 and 1 M.P.H. P.S. respectively. In one case it takes six seconds for the operation of bringing the car to rest, and in the other case, twelve seconds. If we are trying to save time, the first is evidently the proper method. Incidentally brake shoe wear is much less at the higher rate of accelleration and braking because of lower maximum speeds and greater degree of coasting.

CHART NO. 2—COMPLETION OF SPEED TIME CURVES

Combinig the three elements just considered, we obtain diagrams as shown on Chart No. 2. Since the area of this diagram is the product of time and speed, it is a measure of the distance travelled. This illustrates three methods of travelling 600 ft. in forty seconds, an average speed of about 10 M.P.H.

The first method is to accellerate slowly to a certain spped and brake slowly to the stoppping point (Curve "A"). Max. speed—19.4 M.P.H.

The second, to accellerate somewhat faster, coast a certain distance, and brake somewhat faster (Curve "B"). Max. speed—15.8 M.P.H.

The third to accellerate as fast as is practicable, coast as far as possible, and brake as quickly as comfort will permit (Curve "C"). Max. speed—14.8 M.P.H.

The motorman has these three choices or some modification of each.

So far as the passengers are concerned they all accomplish the same end viz: *going* 600 *ft.*, in *forty seconds.*

But there are two very important points to consider here: Safety and Cost.

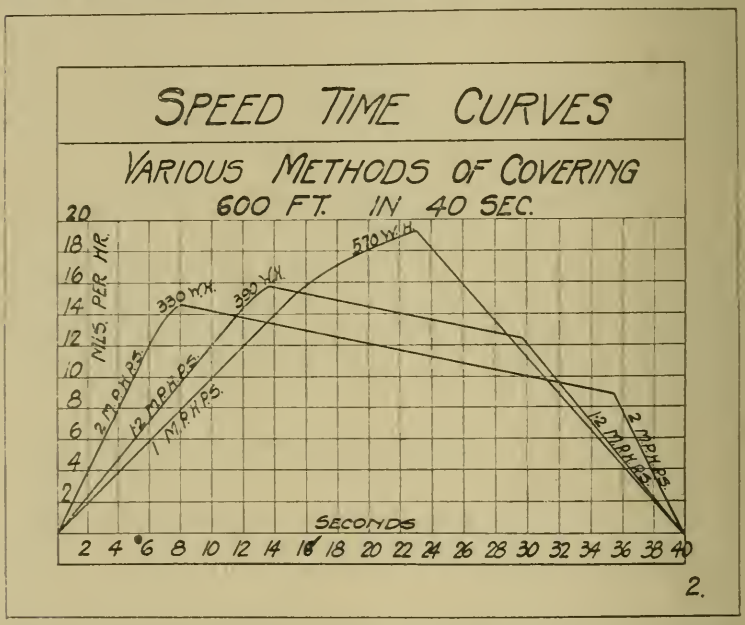
The factor of safety of car operation may be described as the ability of the car to stop quickly in emergency.

If we consider that the possible stopping distance is proportional to the square of the speed at which the car was travelling when brakes were first applied, it will be apparent

that the *safest* way of operating is that in which the car has the *lowest maximum speed.*

A calculation of power consumption reveals the fact that method "A" required 570 *Watt Hours* for the trip; method "B" 390 *Watt Hours,* and method "C" 330 *Watt Hours.* So from the point of view of economy also, once the distance and time are fixed, the practise should be to accellerate and brake fast, and coast as far as possible.

This completes the part of car operation directly in the hands of the motormen. The crew do not fix schedules and



they can only partially assist in speeding up the remaining element of the cycle, viz: the time at rest.

Before passing on however, attention should be drawn particularly to the fact that in this matter of car operation, *Safety and Economy are coincident.*

Since there are such wide variations in possible power consumptions for a given run, it is quite plain that for economy's sake the Companies will do all in their power to encourage motormen to operate efficiently. Many Companies have made large reductions in power costs by educational campaigns supplemented by instruments which recod each car's performance, and have incidentally lowered the maximum

Speeds formerly thought to be necessary for satisfactory operation.

The subsequent argument for higher schedule speeds bears this in mind and nowhere in this paper is a schedule speed mentioned that if efficiently operated will necessitate a higher maximum speed than is frequently observed with inefficient operation at eight miles per hour.

SCHEDULE SPEEDS.

Passing now from individual car runs to the larger question of operation in general, we will connect the argument with the two large factors in which the public and the operating Companies are directly and jointly interested viz: *Schedule Speeds* and *operating costs.* Certain portions of the costs are fixed, others are functions of the schedule speed. We will confine ourselves to the latter, and see in what manner increased schedule speeds affect public convenience, and also operating costs, which of course in turn reflect to some extent on the rates of fare.

It is necessary to show the relative effect of varying the principal factors that bear on the subject of schedules.

These are:—

Motormen's performance or efficiency of car handling,
Gear Ratio,
Time of Stop,
Distance between Stops.

Motorman's performance though very important in some respects, has relatively very little to do with Schedule Speed. As we have seen, it is to everybody's interest to accellerate and brake as quickly as possible, and a certain amount of coasting is absolutely necessary for the sake of flexibility as well as efficiency.

CHART NO. 3.

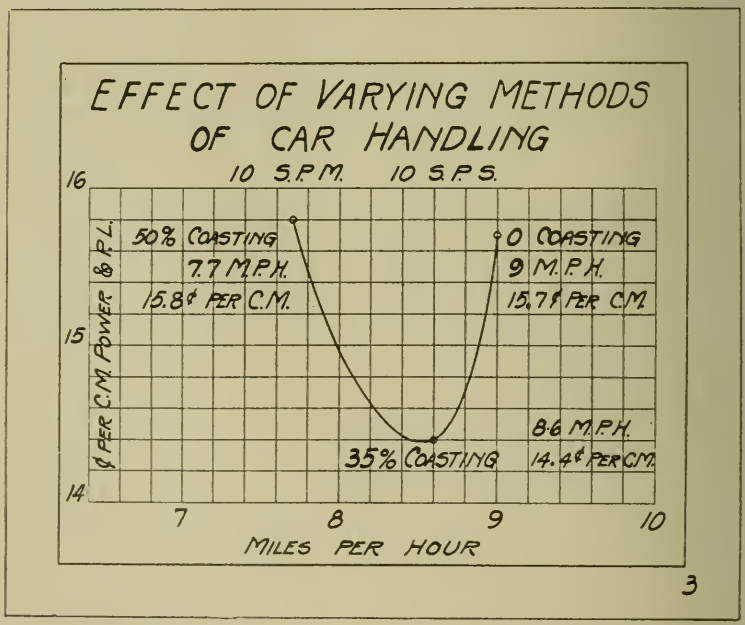
Chart No. 3 shows to what extent, with a given equipment, schedule speeds may be varied by allowing different coasting periods, accellerating and braking rates remaining fixed at the practicable maximum of two M.P.H. P.S.

The highest schedule speed is of course obtained when no coasting is allowed, i.e. power is left on till the moment brakes are applied. Thus for any condition of stop and time of stop there is a definite maximum possible schedule speed. This is fundamental and shows up the fact that no marked improvement in present schedules can be obtained by a manipulation of the car itself.

For instance at *ten stops per mile, ten seconds per stop,* the highest schedule speed possible is *nine miles per hour.* There is no way of increasing this by any changes of car equipment within the practicable limits imposed by accelleration and braking rates.

However in order to have reasonable flexibility, i.e. to allow lost time to be made up, we cannot insist on maximum possible schedules. Furthermore, by increasing the coasting period up to a certain point, the decrease in power consumption more than offsets the increase in platform labor cost.

A still further increase in coasting reduces the schedule



speed to a point where further saving of power is more than offset by increased platform labor, so that for any given distance between stops and time of stop, there is a schedule having minimum cost. This condition obtains when coasting is from 30 to 40% of total time. Note that costs as well as speed are almost entirely dependent upon the question of stops.

At *ten stops per mile* and *ten seconds per stop* the following examples are noted:—

With 0 coasting 9 M.P.H. as maximum possible schedule.

costing 15.7c. per car mile for power and platform labor.
With 35% coasting 8.6 M.P.H. which is the highest practicable speed with all motormen highly efficient; costing 14.4c per car mile.
With 50% coasting 7.7 M.P.H. costing 15.8c per car mile.

It is generally conceded that at ten stops per mile the best that can be expected from average motormen is eight miles per hour.

The important point to keep in mind however, is that no matter how we force a car with unlimited motor capacity under the conditions given, *it is not possible to exceed a nine mile schedule.*

GEAR RATIO.

This subject is rather technical, of interest mainly to equipment engineers. It has been discussed so frequently, to the exclusion of other matters of far more importance, that the fact is frequently overlooked that those other matters do exist. With the narrow range of gear ratios available for city service it is of quite minor importance as will be appreciated from the statement that 30% change in gear ratio of a M.T.Co. Standard Car, allows a variation in schedule of only 6%. The only point worth noting here is that, with higher speed gearing, power costs tend to increase, and that therefore once a schedule is decided on we should use the lowest gearing that will maintain that schedule with sufficient flexibility.

If, however, the question should arise as to the advisability of changing existing gear ratios in order to economize in power cost it may be suggested that it might first be well to study the results that would follow an increase of speed without change of gears.

It may be found that the service will be vastly improved, and equal or greater economies effected at the same time if the efficiency of operation is improved by increasing the speed rather than by lowering the gear ratio to suit prevailing speeds. These are too low to meet modern requirements of transportation.

There is little to be hoped for by altering equipment, and whatever results can be brought about by efficient car handling should certainly be taken advantage of by the operating companies, since it makes for economy at the same time.

The only remaining factors of importance as affecting schedules are the time of stop and the distance between stops, and it will be seen that these have far more effect than any of the factors that are directly under the control of the operating Company.

TIME OF STOP.

When the car is at rest it is benefitting neither the passengers nor the Company, for time standing still is absolutely lost and it should be evident that the sooner the car gets started again, the better for all concerned.

But here is a point in which all street car passengers are vitally concerned, for without their co-operation practically nothing can be accomplished.

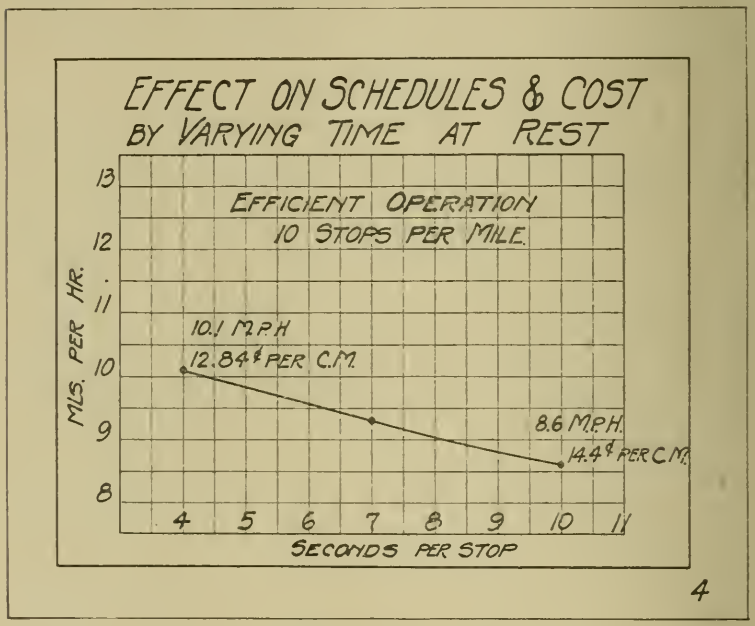


CHART NO. 4.

Chart No. 4 has been prepared from a series of speed time curves such as are shown on Chart No. 2, showing the affect on possible schedules of varying only the *length of time at rest.* The schedules shown are what can be obtained by operating at high efficiency but leaving some flexibility. Average distance between stops has been taken at 528 ft., or ten per mile. Coasting time—35% of total.

When the car is at rest ten seconds each stop, a schedule of 8.6 M.P.H. can be maintained. With seven second stops a speed of 9.3, and with four second stops, 10.1 M.P.H.

Here are evidently some possibilities but the question of cost must not be lost sight of.

If increased schedules entail increased costs we will have to find a compromise which while benefitting the public in the way of better service, will not be a burden in the way of higher fares.

The two large items of cost directly affected by car operation are power and platform labor. Power can be calculated once the run characteristics are fixed, and platform labor is inversely proportional to schedule speed. Combining the two then, will give a very close index of the trend of running costs.

We found that by decreasing the time of stop from ten seconds to four seconds the schedule could be increased from 8.6 to 10.1 M.P.H.

Since no change in the motorman's performance is necessitated by the change in the time at rest, power per car mile will be the same in both cases. Under the conditions stated, power will cost 3.93c. per car mile at 1c. per K.W.Hr

Platform labor at 45c. per hour will cost at 8.6 M.P.H., 10.47c. per car mile, and at 10.1 M.P.H., 8.91c. so that the combined costs are 14.4c. and 12.84c. respectively.

Coincident therefore with the marked increase in possible schedule speed that can be brought about by the assistance of the public, is an equally marked reduction in operating costs.

NUMBER OF STOPS.

Building on this promising result, let us see what the remaining factor, viz: number of stops, will do.

CHART NO. 5.

Chart No. 4 was calculated for 528 ft. stops, or 10 per mile. Using the four second stop which we saw was of advantage to both public and Company, *Chart No.* 5 gives the results of lengthening out these stopping points, within practicable limits.

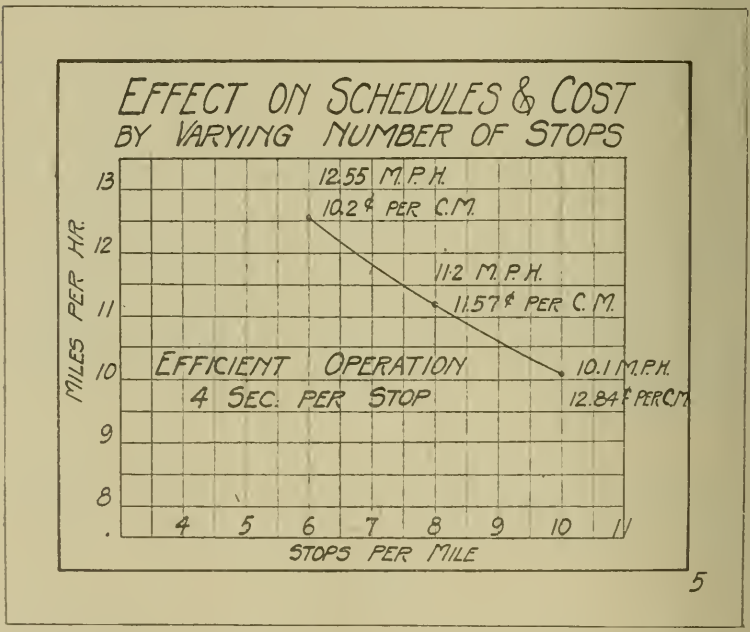
Calculating from similar speed time curves, it is found that at eight stops per mile instead of ten, under equally efficient car handling, a speed of 11.2 M.P.H can be reached, and at six stops per mile, 12.55.

Figuring power and platform labor as before we see them to be:—

at 10.1 M.P.H..... 12.84c.
at 11.2 M.P.H..... 11.57c.
and at 12.55 M.P.H..... 10.2c.

Charts No. 4 and No. 5 are drawn to the same scale to show that reducing the *number of stops is of far greater influence on possible schedules* than even the time of stop, and we saw that time of stop had more influence than car equipment and handling.

Let us see if the increased distance between stops imposes any serious inconvenience.



Ten stops per mile means 528 ft. between stops or 176 ft. average walking distance, aside from cross street travel. At three miles per hour, ths requires thirty seconds to walk.

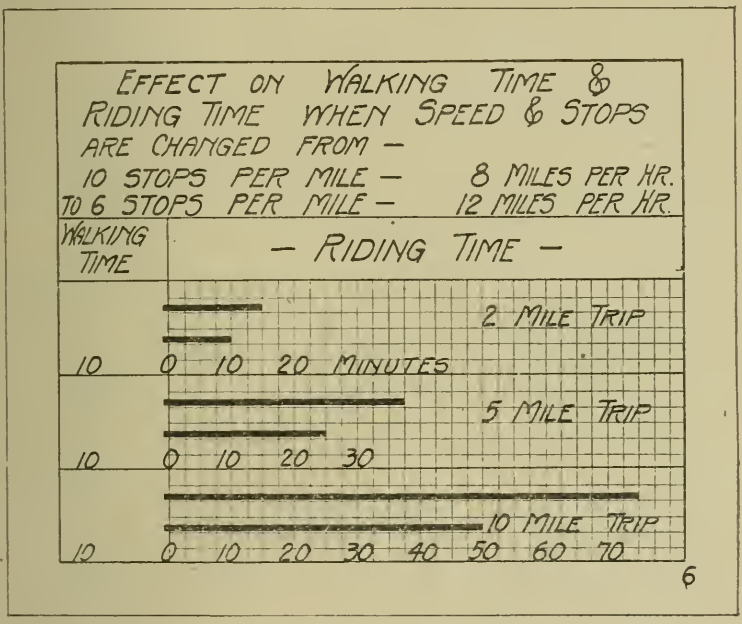
Six stops per mile means 880 ft. between stops or 220 ft. average walking distance, requiring fifty seconds.

Now by having our stops 880 ft. apart and obtaining co-operation for quick movement at stops, we saw that a schedule of 12.55 M.P.H. is possible, or let us say 12 M.P.H. Please remember that this is the only way by which a 12 mile service can be made.

CHART NO. 6.

Chart No. 6 gives some idea of what the difference between eight mile service and twelve mile service means to the average street car riders.

It is suggested that the average passenger walk twenty seconds further. If he is going two miles, he can save five minutes or three hundred seconds. If he is going five miles he can save twelve and one half minutes; if ten miles, twenty five minutes. This for an extra walk of twenty seconds.



The public in a City like Montreal take some 210,000,000 car rides a year. Assume the average ride at two miles. The annual saving of time to the public by twelve mile service as agaist one of eight M.P.H. is 17,500,000 hours, or 2,000 years!

It is worth remembering that this saving to the public in general would be accompanied by a substantial reduction in operating costs and also a marked saving in capital investment since the same service can be maintained with 800 cars at 12 M.P.H. as with 1,200 cars at 8 M.P.H. Cars of a type suitable for heavy traffic in Canadian Cities cannot be pur-

chased just now for less than $20,000 each. Car House Facilities, Car House Expense, etc., would of course be in proportion. Number of cars passing any given point could be increased 50% with same number of cars in service.

It would seem therefore that in view of the prohibitive cost of equipment, during the present period of false values, it would be a sane policy to find way and means to use existing equipment to better advantage before we talk of undertaking capital expenditures to meet the growing demand for transportation.

It might well be asked, can the above reasoning be carried further. The answer is—very much further; but with the provision that the general public will have to realize much more fully even than is necessary for the carrying out of the suggested changes, that street car traffic is by far the most important kind of City Traffic and that nothing should stand in the way of improving it. With nonprotected tracks and even well regulated vehicular traffic schedule speeds higher than 12 M.P.H. begin to approach dangerous conditions on account of the higher maximum speeds necessary.

Provide a curb protected strip—6'' or 8'' high for tracks, on certain streets reserved for express service, stops about 1,500 or 2,000 ft. apart., and protected crossings and there is nothing to prevent a twenty mile schedule.

The unthinking part of the public might regard this as a restriction on their right to wander all over the highway but in actual time, the gain would much more than offset any imagined inconvenience; but let us get the twelve mile service first.

CONCLUSION

The outstanding features to be remembered are:—

(1) That higher schedule speeds are desirable from every point of view. They can be obtained without extra cost and without affecting safety of operation.

(2) The higher speeds will result in an improved degree of comfort and frequency of service because of less overcrowding and shorter headway between cars.

(3) That speeds higher than those now prevailing depend almost entirely on reducing the number and time of stops and that a decrease in the number of stops is of more importance than a decrease in the time of stops.

(4) That convenience is only a relative factor. An extra walking distance of a few feet is of no real mo-

ment when compared with the outstanding advantage of quick transportation. One cannot have private taxi-cab service at Tramway fares but there is no reason why the speed of taxi-cab service cannot be approached.

(5) That appreciably higher speeds cannot be obtained by any possible means within the control of operating Companies. Improved service rests in the hands of the users of street cars. Questions of car designs, motor equipment, routing of cars etc., are all of some importance but their effect on the quality of service is negligable when compared with the possibilities of improvement along the line suggested.

(6) That the bogie of high cost cannot be used as any argument against faster service because higher speeds in city transportation tend toward lowering operating costs.

(7) Higher speeds will result in a more efficient use of existing equipment with the result of curtailing the demand for the non-essential production of rolling stock in favor of the real necessity for greater production of essentials.

(8) It may be stated that it is absolutely essential to investigate every possible means of increasing the efficiency of existing rolling stock in order that we may partly offset the radical demands for increased wages.

Chairman:

Gentlemen, some of the information in this paper should be known to every citizen in Montreal. I think this club exceptionally fortunate to have this paper as a part of its records. every member here tonight should do his part to spread the gospel we have heard as far as he can. The paper is now open for discussion and I shall be glad if everyone will take part in it. Possibly some of us cannot discuss the technical features but we can all at least ask questions and I am sure Mr. Blair will be pleased to respond to any question put to him.

There is one question I would like to ask, in connection with the unit of cost.

Is the cost per car mile the standard unit by which the Tramways Co. keep a line on the cost of their operation, and if so how do they keep the mileage record? Is it an accurate record based on the actual movements of the car or is it

based on the mileage of the tracks and the number of trips made by the car?

Mr. D. E. Blair:

The mileage records are absolutely accurate and are based on actual performance of each individual car in the service, the number of trips and the exact mileage to two decimal points of each trip and the expenditure. A careful record is kept of each car. This forms the basis of most of our cost accounting, but other bases are also used such as "passengers hauled" and "miles of track."

Chairman,

Mr. Blair mentions the fact that it is desirable to take advantage of coasting. I understand at one time the question was discussed of paying the motorman for the showing he could make by reduction in the amount of power used by coasting his car. Is anything like this in existence in connection with the operation of the Montreal Tramways?

Mr. D. E. Blair:

To a very considerable extent,—yes. We have not carried that idea quite as far as in some other cities but have gone to a considerable extent.

Chairman:

We have with us tonight some gentlemen who have come from a considerable distance; some are well known in Montreal, and the club is honored by their presence. I am sure we would all feel honored if they would take part in the discussion. I will ask Mr. Hutcheson if he will favor us with a few remarks.

Mr. J. E. Hutcheson:

Mr. Chairman, I did not expect to be called upon tonight. If I had felt there was any chance of that I am afraid my usual modesty would have prompted me to stay away. I wish to thank you very much for the invitation to speak and for the opportunity to hear the very excellent paper by Mr. Blair. If we could accomplish all that Mr. Blair has said we can, it would be a wonderful thing for the Tramways Co. and for the public as well; but the average street car rider is a selfish individual. The moment he gets on the car he does not want that car to stop for anybody else,

although he takes all the time he wishes to board the car himself. I have listened with great interest to the paper. It is an old subject of discussion between Mr. Blair and myself and I wish to congratulate him on his efforts and also the club on having him here tonight. Probably the best compliment I can pay him is to say that I consider the Tramways Co. is fortunate in having Mr. Blair at the head of the Rolling Stock Department.

Applause.

Chairman:

We have also wish us tonight Mr. G. Gordon Gale, Vice-President of the Hull Electric Company.

Mr. G. Gordon Gale:

Mr. Chairman and Gentlemen. It gives me great pleasure to be here tonight, and I can assure you that I have listened to the paper read by Mr. Blair with much interest. He has presented the subject so clearly and brought out the different points so well, that there is really little room left for any discussion.

Car service is a very live question with every one of us, and now that we have been told what is needed, a responsibility towards the public rests upon each one of us. We who now know the facts must tell others, so that in time all will become impressed with the desirability for the changes which are clearly necessary, if electric street car service is to be carried on at its highest point of efficiency.

Chairman,

I have another question I should like to ask. Some months ago I happened to be in the city of Cleveland and noticed quite a number of "Pay as you Leave" cars. Has that type of car shown any saving or advantages in connection with shortened time at stops for loading and unloading passengers?

Mr. D. E. Blair:

I think Col. Hutchison can answer that question better than I can.

Mr. J. E. Hutcheson:

Mr. Chairman, my experience and opportunity to study the "Pay as you Leave" car have been very limited. I have

seen the car in operation and no doubt it has some advantages, but I am not prepared to say that it would be a better car for Canadian cities than the present car used, as there may be disadvantages that would outweigh the advantages. There will no doubt the time saved in loading as the people will get right in and pay their fares as they are leaving or as they move up to the front of the car. We are not prepared to adopt the "Pay as you Leave" car just yet.

Mr. T. Ahern:

Mr. Chairman, I did not expect to speak at this meeing. Like Mr. Gale, here, I came from Ottawa and that no doubt accounts for my modesty. I have listened to Mr. Blair's paper with a great deal of interest and have some knowledge of street railway problems, — in fact I am responsible for Mr. Hutcheson being in the street railway business, as I was the first person to employ him, and we two are looked upon as the pioneer street railway men of Canada, and I believe Mr. Blair is looked upon as the leading authority in his line. I think we are very fortunate in having him present this paper. In regard to the "Pay as You Leave" car, I have seen it in operation for several years in San Diego, Cal., and I am impressed with that system as I think it would serve to accomplish what Mr. Blair mentions, as the car gets away much more quickly due to the fact that there is no delay by people endeavoring to find change and other incidental delays are eliminated. I think it would be a good idea to encourage this car. It has met with success in Cleveland, and I know it has been successful in San Diego. I think at Ottawa we will make an attempt to introduce that system as it will result in increasing the average speed of the cars and benefit the public. I have watched with interest the developments of your street railway in Montreal, and while we at Ottawa have considered that we had the best railway I must admit that you are giving us a run for our money, as you have a splendid system here. I believe that Col. Hutcheson and Mr. Blair deserve great credit for the results they have obtained. I thank you.

Applause.

Mr. J. E. Hutcheson:

Mr. Ahern and myself have been regarded in Ottawa and Montreal as the pioneer men in the Electric railway industry in Canada, but we have another pioneer here to-

night in he person of Mr. C. N. Duffy, of the Philadelphia Rapid Transit Ca., who is one of the pioneers of the industry in the United States. I think he can tell us something about the "Pay as you leave" car.

Mr. C. N. Duffy:

Mr. Chairman and gentlemen, I feel at considerable disadvantage when called upon to address this body, particularly, as I am not an Engineer nor am I an operating man. I am not an "E.E." or an "M.E." I am just an ordinary official in the street railway business, but I am familiar with operating conditions. I appreciate the opportunity to be here tonight and to listen to the splendid paper given by Mr. Blair which has dealt with the problem, as I see it today, of the street railway business. He has done this in a most comprehensive and thorough manner, and as I said to Col. Hutcheson, the problem today is to educate the public so that they will do their part. I say that with all due respect to the public, as I believe that we in the street railway business today — with all due respect to the officers of the Montreal and Ottawa Tramways Companies and the officers of tramways in other cities in this country — have failed to grasp this important point and have failed to rise up to the situation.

The Tramways Companies are probably more to blame than the public. There are three parties at interest in the street railway business. We have, first, the investors and their interests. Next we have what has been called by our President, Mr. T. E. Mitten, "Management and Men," which has to do with the interests of the investors and the employes and their relation to the third party in the business—and the most important party — the public. We can, we should and we must educate the public, for, as Mr. Blair has pointed out, there is no reason why the average man or woman who rides on the street cars should not ride at twelve miles per hour instead of eight miles per hour when this can be attained by walking a few feet. We have tried to educate the public in Philadelphia along these lines and have succeeded fairly well. To answer one of your questions, Mr. Chairman, the car mile is the one best unit for the measurement of operation of street railway performance. This is my judgment regardless of whether you consider the receipts or the expenses, but that must be qualified to a certain extent on account of the element of the speed of the cars, because you might run a car on one line at twelve miles per hour and

earn $5.00 a car hour in receipts, but on some other line you might earn $5.00 per car hour and run at ten miles per hour. This would make a difference in the receipts per car mile. As Mr. Blair has said — to determine the cost of power and platform labor, the car mile unit is the proper unit to use.

With regard to the type of cars, every city and every property has its own conditions and these local problems must be worked out accordingly, as what might be a very good thing in one city would not apply in another, and this must be taken into consideration.

If Mr. Blair were in Philadelphia he would realize the importance of the "skip-stop" and the reduction in the cost of the service to the public which can be made, and this is necessary now more than ever before on account of increased fares. That is where the public has an important place in the three-partnership arrangement. In 1920 our cars operated, exclusive of stops, something over ten miles per hour and including stops something over nine miles per hour.

I am impressed with what Mr. Blair said about the "Banana Stand" on the corner being able to control the riders of the cars. In most cities the street railways transport the entire population or its equivalent once every twenty-four hours, yet this "Banana Stand Man" on the corner is able to make his voice heard above the 900,000 people of Montreal and the 2,000,000 people of Philadelphia, as, with all due respect to our Public Service Commission, it was necessary for us in Philadelphia to put back some of the stops that had been cut out.

In regard to the "Pay as You Leave" car, we have gone from the "Pay as you enter" car to the "Pay as you leave" car, and now to the "Pay as you pass" car, and we consider the "Pay as You Pass" car the most satisfactory. It is quickly loaded, and there is more certainty of getting all of the fares, which is a very important consideration. In the "Pay as You Pass" car, there are two front entrance doors. You walk into the car and if you do not want to pass the conductor you do not need to, but most of the passengers will prefer to pass to the rear of the car and as they pass the conductor they pay their fare, or if they do not do this they pay when they leave the car. The collection of fares is thus made a greater certainty and the work of collecting is much easier on the conductor. But, as Mr. Hutcheson says, there may be objections to a car of that kind in this city.

I want to congratulate the city of Montreal on the splen-

did street car service that is provided here by the Montreal Tramways Company and on having Col. Hutcheson and such a competent staff to operate the property.

Mr. Norman Holland:

It is always necessary to inject into the meeting a little of the spirit of fun, although it is somewhat difficult to find the funny side of a serious sucject such as presented tonight.

On page 37 Mr. Blair refers to a saving of 2000 years that the public might make by increasing the speed of the street cars, but even in the Province of Quebec, who would want to live 2000 years?— Laughter.

There were recently discovered some cuneiform tablets of the Chaldean Period, which were supposed to represent a big meeting held at the time of Methuselah, when he was 940 years old. The description presents the scene of an Egyptian Queen complimenting Methuselah on his young appearance, — she said: "You dont look a day over 900.— Laughter.

Some of the remarks here have bought to my mind the trouble that our French Canadian conductors have at times due to ladies getting off the cars backwards. In one case a lady had accomplished this but barely escaped falling, and the conductor said to her, "Lady, when you get off the cars, you should get off with your face in front of you." — Laughter.

In another case a man behind a street car, in a flivver, insisted on stopping suddenly behind the car each time it stopped and on one occasion nearly struck it. The conductor said to him: "If you want to come on board, you'll have to put your top down," — Laughter.

Mr. Duffy referred to the carrying of 900,000,000 passengers per annum and I was wondering if we all realize just what that means. If the Tramway Co. had had a street car standing at the corner of "Bethlehem Street," on the day Christ was born, and a passenger had boarded that car every minute, 60 every hour, — from that time until the present, the number would have gone just a little over the 900,000,000. — Quite a lot of fares to collect. — Laughter.

Mr. W. G. Gordon:

In Mr. Blair's paper he points out in one place the delay that occurs by passengers finding change in tpaying fare. This reminds me of the first time the "Pay as you Enter" car was

introduced in which a picture was presented of an old lady paying her fare in one of these cars.

The old lady got on the car and blocking traffic, opened her bag and took out her purse—closed her bag—opened her purse and took out ten cents — closed her purse, — opened her bag and put in her purse — closed her bag. Handed ten cent piece to conductor and received five cents change. She opened her bag and took out her purse — closed her bag. Opened her purse and put the five cents in it, — closed her purse. Opened her bag and put in her purse, — closed her bag. Then she moved along into the car.

Laughter.

Mr. Blair has shown by a series of clearly reasoned steps that the most important factor in increasing the schedule speed is a reduction in the number of stops per mile. The second most important factor is a reduction in the time of stop. The time taken in loading and unloading has been greatly reduced by the use of smaller diameter wheels made possible by the development in the last few years by the Electrical Manufacturers of the fully ventilated type of railway motor with higher armature speed. This type of motor is much lighter and smaller for any given service requirements than the older type of totally enclosed motor. With the use of the ventilated type of motor lighter trucks are used and a more economical design of car body obtained resulting in constant saving in energy as the weight of the car has to be moved, whether empty or loaded to capacity.

I thank you, gentlemen, for the invitation to be present, and wish to express my appreciation of Mr. Blair's excellent paper

Col. F. M. Gaudet:

I feel very much like a stranger in a meeting of this kind having been in Montreal but comparatively short time. However, I have been up against the traffic problems, and as you have kindly invited me to speak there is one question I should like to ask Mr. Blair He refers, on page 24 of his paper, to the zone of safety, and as the police have had difficutly in dealing with street car traffic I should like to ask Mr. Blair on what streets he considers such zones should be placed. As the streets are narrow it is somewhat difficult to put them in, although if the streets were wider we might give this some consideration and see what can be done.

Mr. D. E. Blair:

Not having charge of the operation of the cars on the system, I would not like to make any suggestions personally. I appreciate of course that the streets are very narrow and it would be difficult to put this into effect without interfering with the vehicular traffic. I think, however, in view of the importance of the street car traffic to the public that vehicles ought to be requested to take another street around congested corners at certain hours. As to the location of these safety zones. Col. Hutcheson may be able to suggest something.

Col. F. M. Gaudet:

There is another question. You have also mentioned the co-operation of the police to prevent overcrowding. I do not yet understand just what control the police can have over this.

Mr. D. E. Blair:

I am afraid it is entirely beyond the capacity of a single conductor on the back of the car to prevent overcrowding. The street car companies have made many efforts to control this but have given it up. I believe that the cooperation of the police force at certain street corners would serve to impress upon the public the disadvantages of overcrowding, but it would require quite a large force of policemen to carry out a campaign of this kind.

Chairman:

In the operation of the tramway cars, those of us who have used them extensively have no doubt noticed the part that the man-element plays in the game. I refer to the conductor, the man on the back platform. Possibly many times we fail to give those men the consideration that we should. I wonder if any of us have taken the trouble to speak a kind word for the conductor who gets his passengers on the car quickly and gets his car away. I reside in Notre-Dame de Grace and use the tramway cars frequently. There are some conductors on that line who are real artists. I remember one especially who always has a good word for everybody, and who encourages the passengers to board the car quickly and gets his car away promptly and creates a good feeling among his passengers. Such men are big assets to the Tramways Co.

Mr. R. J. Beaumont:

I have listened with great interest to the speakers this evening and have enjoyed the first class paper that has been given. I cannot myself speak with authority on this subject, as the small road with which I am connected in Three Rivers, is not one upon which much experience can be developed. We have only seven miles of track and have been in operation about five years. We started out with the single-man cars. In view of the size of our operations I do not think I could add anything of interest to the meeting. I thank you.

Mr. W. F. Graves,

Mr. Chairman and gentlemen, it is rather unusual to see so many tramway men at a public meeting. We always have so many criticisms thrown at us that it is the better part of discretion to stay away — laughter — and the Chairman of this meeting appears to be a very rare exception. If it is a fact, however, that we move every man, women and child in Montreal once every twenty-four hours, it seems to me that they all have some complaint to make, but the Chairman has grasped the situation correctly and appears to be one in a thousand.

Mr. A. C. Towne:

I use the tramway frequently and am a confirmed "strap-hanger". I would like to ask Mr. Blair about the efficiency of the motorman and how that is taken care of. Is he required to make any specified time in running the car?

Mr. D. E. Blair:

The cars are operated on a regular schedule just the same as any steam railroad. Where delays occur it is generally the fault of the traffic on the street and is not due to the operation of the car.

Mr. O. W. Meissner:

Mr. Blair has mentioned "reductions of power used by educational campaigns supplemented by recording instruments." Many railways have interested their men in a competition in which they are each given a score card and a recording instrument on each car, which shows the number of minutes power is used by each man on his shift. Comparisons of efficiency are made and periodically prizes are distri-

buted. Results obtained show from 20% to 50% increase in the motorman's efficiency, from 10% to 30% reduced power consumption, a substantial saving in brake shoes, wheels, trucks, motors, car bodies, rails and road bed, also less accident reports and claims to be settled, better co-operation between conductor, motorman and the public, passengers are loaded and unloaded more quickly, stop periods are shortened, and coasting time is lengthened, schedules are better maintained, the men are more contented, they are playing a worth while game and their work becomes a pleasure.

The recording instruments used are very simple and can be understood by any man who knows what a minute is, and it has a decided physiological effect on the men.

Mr. J. Murphy:

I would just like to add my tribute to the others presented to Mr. Blair for the excellence of his paper. I have *no criticism* to make; I agree with everything he has said. I believe it will appeal to us all as sound policy to make the best use of present equipment, in tramway service, instead of going into huge capital expenditures for additional equipment. Some of you may recall that when our good neighbours to the South of us entered war they suddenly found they had 88,000 employees at Washington working for the Government. They all had to arrive at work at 9.00 a. m. and they left off work at 4.00 p. m. The street cars in Washington, as a result, were tied up during rush hours. Twice as many cars were necessary to handle the crowds and it was shown that the power plant should be doubled in capacity, at least, that's what everybody said. An *engineer* was employed to find out just how many additional cars and just what additional power plant were necessary to take care of the enormous traffic. After carefully going into the matter this man showed that *no additional cars and no additional power plant* were required at all. He suggested that the hours for starting and stopping be "staggered"; that is, that a certain group of employees start at 9.00 a. m. and quit at four p. m. the same as formerly, and the other group start and quit at different times — 15 minutes apart. He also suggested that the lunch hour be "staggered". This system was adopted and worked out with absolute satisfaction. The same equipment of cars and power plant served the people better in every way The lesson from that incident is this: When the life of a city is affected by street car troubles or

other matters of an engineering character, those matters should be turned over to an engineer of the Mr. Blair's type. Such a man vested with authority soon solve the most intricate problems.

Chairman:

There is one more question I would like to ask. Has the system of braking cars by regeneration ever been tried on street cars? That system has been applied to electric locomotives and used with considerable success. It consists of converting the motors into generators during the braking period and putting the power back into the line.

Mr. D. E. Blair:

This has been considered but it is not adapted to the type of motor used on street cars, although it is used on electric locomotives which are equipped with the A. C. motors. The system has been experimented with in Australia and in England by putting special winding in the motors, but the cost would offset any of the benefits that may be derived. It is really necessary to use a motor of special type.

Chairman:

What is the weight of one of the modern tramway cars in this city?

Mr. D. E. Blair:

Our standard car weights 42,000 pounds light. It would weigh about 28 tons loaded. It is equipped with four motors, each 50 h. p. capacity on a one hour rating.

Mr. W. G. Gordon:

Mr. Blair may possibly have been misunderstood in his statement that the regenerating feature could not be used in connection with street cars motors. It is practicable on the small motors of street railway cars the same as in the case of the larger motors, but it would cost more than it is worth.

Mr. E. B. Tilt:

I am sure that it has been a great pleasure to those of us who are not transportation men to listen to so many interesting things about the street railways. My experience in tramway operation has been in the paid fare group and I have learned more tonight about the essentials of good tramway

service than in all the years that I have ridden on street cars.

I believe in educating the public as to its part in assisting to render satisfactory tramway service and I have no objection whatever to doing my part to benefit the company and my fellow traveller but I do want to see some reflection of the benefits derived shown in reduced fares. This viewpoint is however apart from the technical consideration of how to improve the service.

As an old friend of Mr. Blair there is very little I can add to the nice things said tonight about him and his most interesting paper. He bears his honors with his usual modesty and I know his goodness of heart and other splendid attibutes and I should like to confirm all that has been said and then multiply it several times. Therefore Mr. President, it is a great pleasure for me to propose on behalf of the railway club, a vote of thanks to Mr. Blair for his very fine paper presented this evening.

Mr. H. J. Dyke:

There is one question I would like to ask. As we all know, the stopping places for the tramways are marked up on the poles. Some of these are in the middle of the block and some are on the other side of the street, and I hav noticed on several occasions that the cars pass after the individual has walked up to board it. On one occasion I wished to board a car and it did not stop, so I ran to the next stopping place and got there just in time to have the conductor close the doors on me. Being anxious to get on, I knocked pretty hard on the glass door and the glass broke. I was honest and did not run away, and it cost me $17.00 for that glass.—Laughter.

I believe that an improvement could be made in connection with these stopping places and that considerable time could be saved if people knew just where the car was going to stop. I believe also that if the Tramways Co. will promise a reduction in fares to the old five cent rate, they can readily get the runs between stops extended, but not in any other way. — Laughter.

Mr. D. E. Blair:

That matter at the present time is entirely in the hands of the Tramways Commission. I believe that Commission are at present considering the cutting out of certain stops, but in a city like Montreal where the streets are so close together

it has been very difficult to set the limit of 600 feet which the Commission are making an effort to do at the prseent time, and in many cases compromises have been reached, but I believe we shall soon see the distance between stops stretched out further. I think this thing which is so necessary will come in time and we shall in a few years see these stops stretched out so they can be made at convenient points.

Chairman:

You have heard the motion, gentlemen. All in favor please signify in the usual way.' — Carried, applause.

Chairman:

Mr. Blair, in the name of the Canadian Railway Club and personally, I wish to thank you for the very fine paper you have given us this evening. It will be a wonderful addition to our records. I wish also to thank all those who have taken part in the discussion to-night. I think it will be productive of a great deal of good.

Mr. D. E. Blair:

I appreciate your kind remarks very much.

Chairman:

May I call attention to the subject of our paper for next meeting. It will be given by Mr. S. Lynn, General Master Car Builder of the Pittsburg & Lake Erie R.R., on the "Repairing of Steel Freight Cars." The P. & L. E. R. R. was one of the first equipped for the repairing of steel cars. We have a good many steel freight cars and the problem of repairing them is a vital one today. Mr. Lynn will illustrate his paper with a number of lantern slides. I hope all the members will advertise that meeting well, so that we hay have an exceptionally good turn-out.

I wish to call attention to the coffee and sandwiches at the rear of the hall, which I hope you will stay and partake of. If there is no further business we will adjourn.

OUR 18th ANNUAL BANQUET.

At one of the largest banquets the Club has ever held, at the Windsor Hotel on Saturday night, January 29th, 1921, the chief speech was given by Hon. F. B. Carvell, chairman of the Board of Railway Commissioners.

The chair was taken by Mr. W. H. Winterrowd, chief mechanical engineer of the Canadian Pacific Railway. With him at the head table were Hon. F. B. Carvell, chairman of the Board of Railway Commissioners; Stephen Leacock, McGill University; W. W. Butler, president of the Canadian Car and Foundry Co.; Acton Burrows; George Hodge, assistant to the vice-president of the C.P.R.; Maxwell Murdock; Prof. Wilger, Queen's University; H. H. Vaughan, A. A. Goodchild, W. McNab, R. M. Hannaford, T. C. Hudson, J. Hendry, E. E. Lloyd, W. A. Booth, and other representatives of various transportation organizations.

Service to Railways.

After proposing "The King" the chairman proposed the toast of "The Railways." In presenting this, Mr. Winterrowd said that the Railway Club had been organized in 1903, as a medium for the exchange of experience and knowledge by Canadian railway men. For eighteen years it had served this purpose well and had rendered a great and distinct service to the railways, by which it had become a factor for the general good of the Canadian community.

"It is not necessary to emphasize to you railway men the power for good that the railways exercise in every community, as the greatest civilizing agency the world has ever known." The railways, especially those recently constructed, he said, had altogether changed existing conditions. They had transformed desert plains into lands of wealth and promise of greater wealth, extended the markets of the world, brought isolated communities into closer touch and united peoples with a bond of interest previously impossible.

In Canada the railways within the memory of those present had linked the Atlantic with the Pacific and changed the western plains from the home of the buffalo to one of the granaries of the world. In this way the railways developed the wealth of countries and added to the resources of nations. They had become the arteries bearing the life blood of nations, and were maintaining many millions of people.

For the settling of the many questions which arose in this great business, Mr. Winterrowd said Canada was fortunate in the formation of so able and impartial a tribunal as the Railway Commission. Many great questions had been submitted to this board, he said, and the judgments had invariably been fair and just to all interests. He therefore coupled with the toast to "The Railways" the name of Hon. F. B. Carvell, chairman of the Railway Commission, "the stern and righteous judge who holds our destinies in the palm of his hand."

Mr. Carvell pointed out that the main business of the Railway Commission for several years past had been to settle rates, both for the railways, the express companies, and the telephones. He emphasized the fact that so long as he was to preside over the Railway Board, freight and other rates would be fixed so as to make it possible for the railways to be operated on a basis which would pay running expenses and allow for a reasonable profit on the investment. In this connection Mr. Carvell said that in Montreal and the Maritime Provinces there was no trouble about giving the railways reasonable rates. But he insisted that whether a railway were owned by the Government or a corporation, it must have rates sufficient to make a proper profit, and that was his guiding principle as chairman of the Railway Commission. He also issued a word of warning that railway employees, especially on the Government railways, must give a proper return for their wages.

Rates must be fair.

Hon. Mr. Carvell was received with much applause. He referred to 25 years spent in practicing law, and the time he had spent codifying the railway laws. But after a year and a half as chairman of the Railway Commission he had come to realize that the carrying on of the railways was a business in a class by itself.

During the past two years I have had much reason to change my ideas regarding our railways. Without our railways Canada cannot progress. These railways must go on no matter what happens.

Proceeding, Mr. Carvell said that the great question the Railway Commission had to consider was that of rates. They had had to consider the telegraph rates, the big railway rate

case, the application for increase in freight rates and the application of the Bell Telephone Co. for an increase in rates, so that practically everything in Canada connected with transportation had come before the Railway Commission.

"These people do not come before us for an increase in rates unless they require it. The great point I have found is to see if these demands were justified. So far as Montreal is concerned there is no trouble. Give any railway or other company what is reasonable and people will say it is all right. Down east, where I come from the people do the same, I have nothing to say for the rest of the country, I do not blame them, but the people there seem to have sentiments differing from the rest of Canada." (Laughter).

In Parliament, said Mr. Carvell, he had had very decided views, and a year and a half with the Railway Commission had strenghthened them. "But whether a railway is owned by a corporation or by the Government I consider that it should be granted rates sufficient to allow it, if efficiently and honestly administered, to pay maintenance, interest on investment, and something beside that. (Applause).

"Whether it is a Government or privately owned road the rates should be sufficient to supply cost of administration and pay interest on the investment. And so long as I occupy my present position I shall continue that idea as my guiding principle in dealing with these questions of rates." (Applause).

Warning to workers.

As to wages, Mr. Carvell said this was not a matter particularly concerning the Commission, but when present rates expired a year and a half hence the public and the employees must realize that there should be a readjustment.

"I am not discussing wages," he said, 'but a bigger question, that of the service employees are giving their employers on the railways. It has been stated that the Canadian people are receiving the cheapest railway service in the world. But if we are paying too much for such service there is cause for complaint. I believe that in some classes of railway work we have not been getting the returns we should for the wages paid."

There was a remarkable condition of affairs in railway work in Canada. There was the C. P. R., probably one of the best conducted transportation systems in the world. But even this company, after the freight increases granted last

fall, was barely able to pay dividends on capital stock. The old Grand Trunk had not been able to pay dividends, while the Government railways had not come near paying interest on investments, it being stated that the deficits for the past year would amount to between $65,000.000 and $70,000.000. "Do you realize," he asked, "that Canadian National Railways deficit eats up the whole return of the income tax and the business profits tax?"

Difficulty of C. N. R.

Mr. Carvell said that the men managing the Canadian National Railways were capable and conscientious, but they had a tremendous proposition, with a road running through hundreds of miles of territory where it was a human impossibilty to make it pay.

"Only one set of rates can be used for all railways," said Mr. Carvell, "you must face conditions as you find them. The Government must consider the C. N. R. as well as the C. P. R., and it is the duty of all public bodies to support the C. N. R. I was always opposed to it, as many others were. But whether we favor Government ownership or not we have it, and within a year more than half the railways in Canada will be under Government ownership. I am not so sure that it was necessary to take over the Grand Trunk, but we have these lines, and the people must face the situation. I would impress upon the employees of the National system that they must give the same efficient service as those of the C. P. R., forgetting the common idea of those serving government owned businesses.

"As to that," continued Mr. Carvell, "we shall deal with the Canadian National Railways in exactly the same way as the C. P. R. So long as I am there the guiding star of the Railway Board will be the consideration whether the roads should have what they ask for or should they not, in the interests of the people."

Up to the Railwaymen.

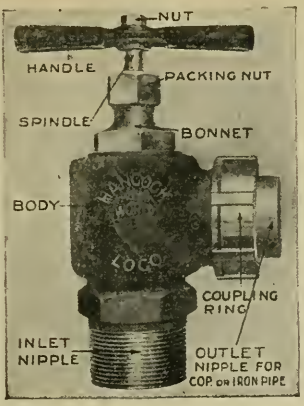
There were two systems, one which could pull through, and another which was handicapped financially, and he wished to impress upon every man in Canada that the only way to make the Government and C. P. R. systems successful was for every employee to give the best that was in him to the

service. "Do that and you will put the railways of Canada in position to give better service than they have in the past few years. It is up to you railway men I am facing tonight to do your share to see that the Canadian railways can be operated under normal conditions, pay dividends on investment, and be carried on as running, paying concerns."

The toast of "Our Guests" was responded to by Dr. Stephen Leacock, of McGill, in an address which happily combined humor and an optimistic idea for Canada's future. Since the war, said Dr. Leacock, Canada had made such progress throughout the world, that the old idea of apologizing for her had been completely forgotten.

Mr. W. W. Butler responded for the railway supply men. He pointed out, that many of the modern investments regarding steel cars had originated in Montreal, revolutionizing the freight carrying business. He remarked that is was odd for the Government to talk so much about unemployment when it was giving no orders for new cars, although an order for cars for their railway system would furnish employment at many centres throughout Canada. It was impossible to expect anything but deficits on the Canadian National Railways unless they ordered sufficient equipment to handle the traffic, and be considered that the C. N. R. management was not doing its duty in the matter of ordering sufficient material to handle their traffic.

During the evening a lively musical and vaudeville entertainment was given, under the able direction of Mr. Norman Holland.



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